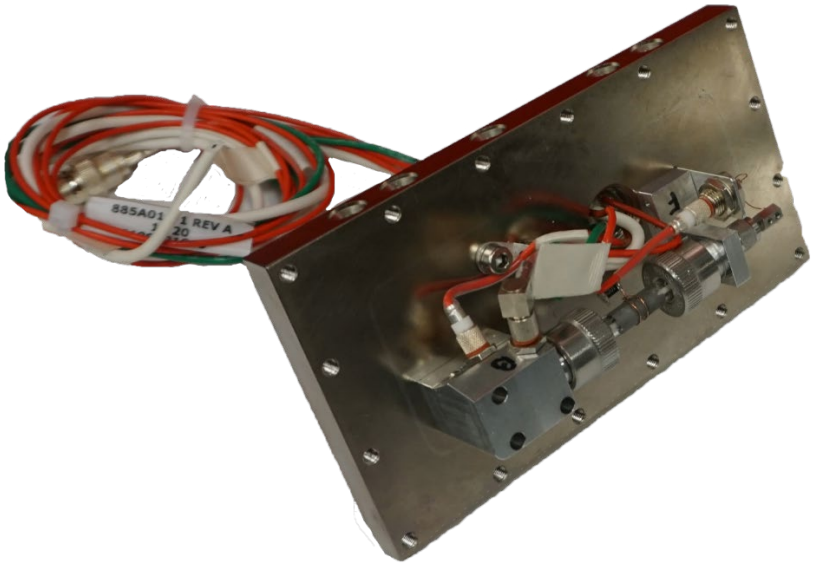
ABB MEASUREMENT & ANALYTICS | 892J009MNAE

PGC5000 Gas Chromatograph

Dielectric Barrier Discharge Ionization Detector (DBDID)

SERVICE INSTRUCTION



Measurement made easy

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Safety

Read these instructions carefully before installation and commissioning. These instructions do not contain all details on all types of products and do not explain all assembly, operating, or maintenance scenarios. Ask the manufacturer for further information.

The content of these instructions is neither part of nor provided for changing a previous or existing agreement, promise, or legal relationship. All obligations of ABB result from the respective sales contract, which also contains the full and solely valid warranty clauses. These are neither limited nor extended by the content of these instructions.

Observe warning signs on packaging and on the device.

Assign only qualified and authorized specialists for the assembly, electrical connection, commissioning, and maintenance of the equipment. Specialist qualifications include:

- Training or instruction and/or authorization to operate and maintain devices or systems according to safety engineering standards for electrical circuits, high pressures, and aggressive media
- Training or instruction in accordance with safety engineering standards regarding maintenance and use of adequate safety systems

WARNING: According to IEC 60900, use only sufficiently insulated tools for the electrical connection.

Also consider the following regulations:

- The applicable standards and safety regulations concerning the construction and operation of electrical installations
- The regulation on technical working materials (safety guidelines for tools)
- The regulations and recommendations relating to explosion protection
- The recommendations for safe working in the case of installation in a Safety Integrity Level (SIL) loop.
- The regulations that apply in the country of use

Safety symbol conventions

The following conventions appear throughout this document:

DANGER and WARNING hazards relate to personal injury and NOTICE hazards are associated with equipment or property damage. However, under certain operating conditions, operating damaged equipment can result in a degraded system or process performance leading to serious or life-threatening injuries. Therefore, compliance with all DANGER, WARNING and NOTICE hazards is required at all times.

DANGER – Serious damage to health / risk to life. These symbols, and the signal word "DANGER", indicate imminent danger or electrical hazard. Failure to observe this safety information will result in death or severe injury. The text may state the hazard, how to avoid the hazard, and the result if not followed. The lightning bolt is for electrical danger; the exclamation point is for general dangers.

DANGER – Serious damage to health / risk to life. This symbol, and the signal word "DANGER", indicates imminent danger or explosive hazard. Failure to observe this safety information will result in death or severe injury. The text may state the hazard, how to avoid the hazard, and the result if not followed.

WARNING – Bodily injury. These symbols, and the signal word "WARNING", indicate a potentially dangerous situation. Failure to observe this safety information could result in death or severe injury. The text may state the hazard, how to avoid the hazard, and the result if not followed. The bolt is for electrical warnings; the exclamation point is for general warnings.

NOTICE – Equipment damage or loss of data or cybersecurity risk. This symbol indicates a potential for equipment damage, loss of data or another unintended outcome. Failure to observe this information may result in damage to or destruction of the product and / or other system components.

IMPORTANT NOTE: This symbol indicates operator tips, particularly useful information, or important information about the product or its further uses.

Potential safety hazards

DANGER – Serious damage to health / risk to life. Ensure that there are no hazardous or flammable gases present in the immediate area of the analyzer. Protected enclosures that rely upon air purge and pressurization will be jeopardized when the protected air is removed. During this non-purged time, a danger exists for fire, explosion, damage to property, and injury or death to plant personnel.

WARNING – Bodily injury. high voltage safety: The DBDID uses a high voltage alternating current discharge to create a plasma. The system operates at a high voltage and a low current which is applied to the glass reactor tube at the round metal electrodes. This electrode should be covered with the plasma shield whenever the plasma is operating.

Before performing any maintenance procedures or adjustments to the plasma cell, make sure the power is off. The best way to do this is to remove the power pack from the main line. This will ensure that the plasma cell is not at voltage.

If the center rod of the plasma supply is not connected to ground, the center rod will have voltage on it (approx. 40 Volts) and **it will shock maintenance personnel.** It will also spark when connecting the ground wire to the center electrode; **do not do this in a hazardous environment.** ABB recommends turning the plasma power off, allowing a minimum of 20 seconds for the DBDID to discharge and then connecting the center electrode to ground. If done in the proceeding manner, the center electrode will not spark.

DANGER – Serious damage to health / risk to life. Ensure there is no hazardous atmosphere present when performing maintenance on the unit. Do not separate components when energized. This applies to all connectors and connections, cabling and wiring.

NOTICE – Equipment damage or loss of data. Printed circuit boards and other electronics are electrostatic discharge sensitive. Ensure that proper ESD measures are taken, as defined by location.

1.Introduction

This service instruction is for reference when installing, operating, and servicing the ABB PGC5000 Dielectric Barrier Discharge Ionization Detector (DBDID). It is for use only by qualified personnel.

WARNING – Bodily injury. Servicing of this product shall be performed by individuals who are knowledgeable of the procedures, precautions, and hazards associated with equipment containing hazardous energy circuits.

1.1 Usage

Dielectric Barrier Discharge Ionization Detector (DBDID) is used in the ABB PGC5000 Process Gas Chromatograph.
It is used to detect parts per billion (ppb) and parts per million (ppm) concentrations of the following applications:

- Impurities in high purity gases and products
- Halogenated hydrocarbons
- BTEX (Benzene, Toluene, Ethylbenzene, and Xylenes)
- Arsine and phosphine
- Ethylene oxide
- Ammonia
- Nitric oxide in cold box applications
- Ambient air applications

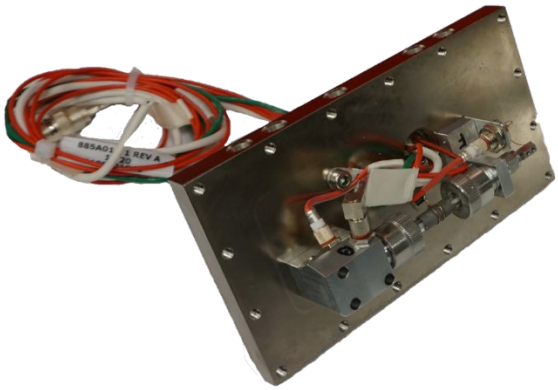
1.2 Measurement Principle

The dielectric barrier is a plasma discharge obtained using a high voltage alternating current applied to a gas as it flows through a dielectric material. The gas is typically helium or argon, and the dielectric material is a quartz or Pyrex tube.

Two electrodes are arranged within the detector. When high voltage is applied to the gas, a breakdown occurs with a subsequent discharge from one electrode to the other electrode. The presence of the dielectric barrier behaves as a capacitor in the localized region of the discharge. As such, the dielectric barrier stores a substantial amount of energy for each discharge resulting in the generation of highly excited state of the helium (or argon) atoms. This is called the reaction gas.

The sample components are ionized when they elute from the column. A second set of electrodes measures the current generated from these ionized components. The output is sent to an electrometer where it is amplified, measured, and displayed.

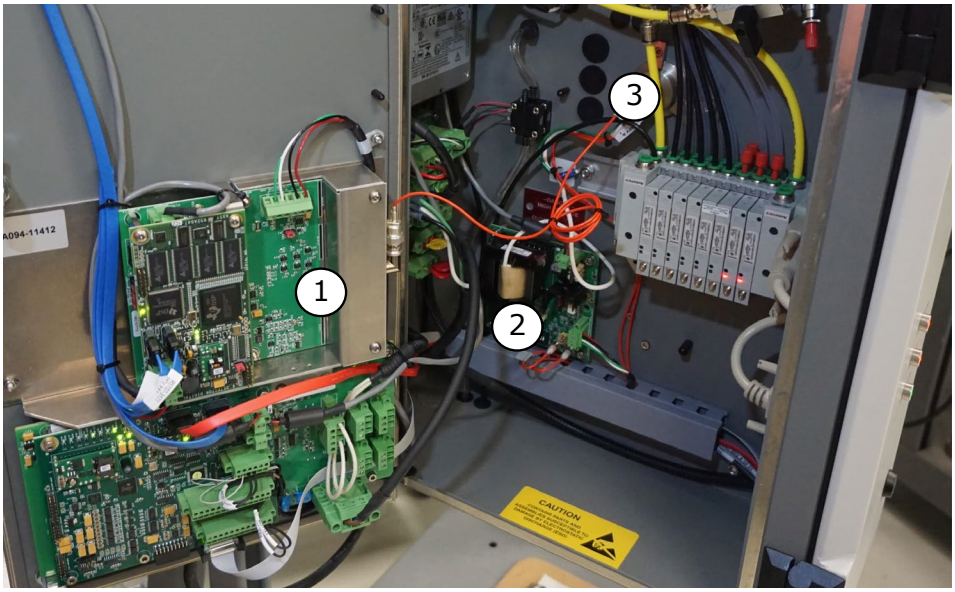
Figure 1-1: Dielectric Barrier Discharge Ionization Detector



2 Service and maintenance

The following chapter includes a list of replacement parts, instructions for replacing spare parts, and other maintenance procedures for the Dielectric Barrier Discharge Ionization Detector (DBDID).

Figure 2-1: PGC5000 Electronics compartment open



Legend: PGC5000 Electronics compartment open

Item	Description
1	DBDID amplifier assembly
2	DBDID power supply board
3	Flange nut

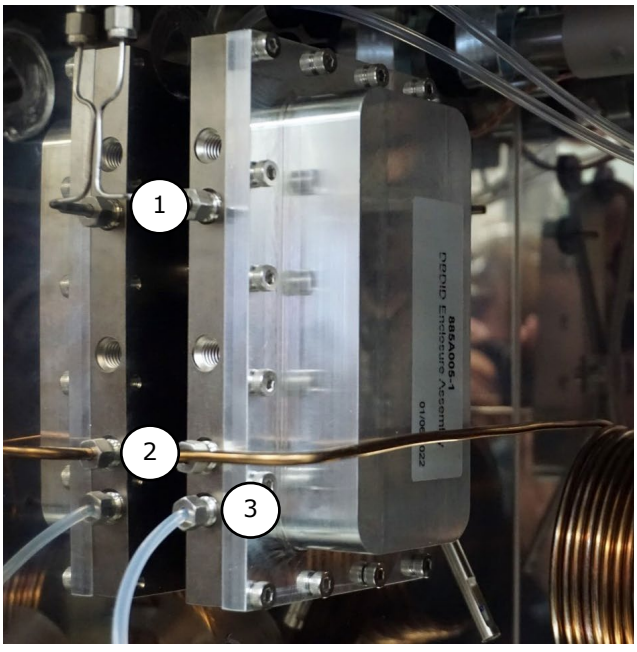
2.1 Detector removal

WARNING – Bodily injury. High voltage present. Make sure that power to the PGC5000 has been disconnected before removing the detector.

To remove the detector from the PGC5000, perform the following steps:

1. Disable the isothermal oven temperature zone and allow the oven to cool to room temperature.
2. Power down the oven.
3. Disconnect the column, cell vent line and the reactor gas inlet from the cell body. See items 1-3 in Figure 2-2.

Figure 2-2: Disconnect lines

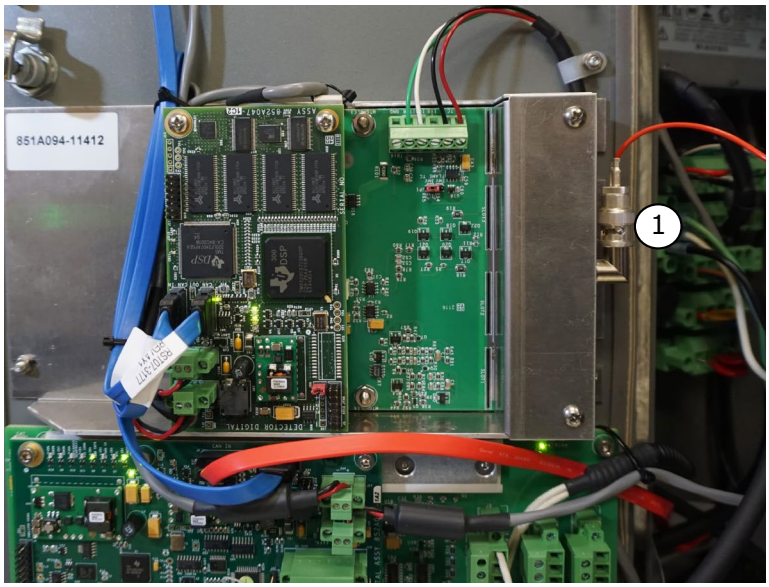


Legend: Disconnect lines

Item	Description
1	Reaction gas inlet (plasma gas)
2	Detector inlet (chromatograph column connection for analytes to the detector)
3	Detector vent

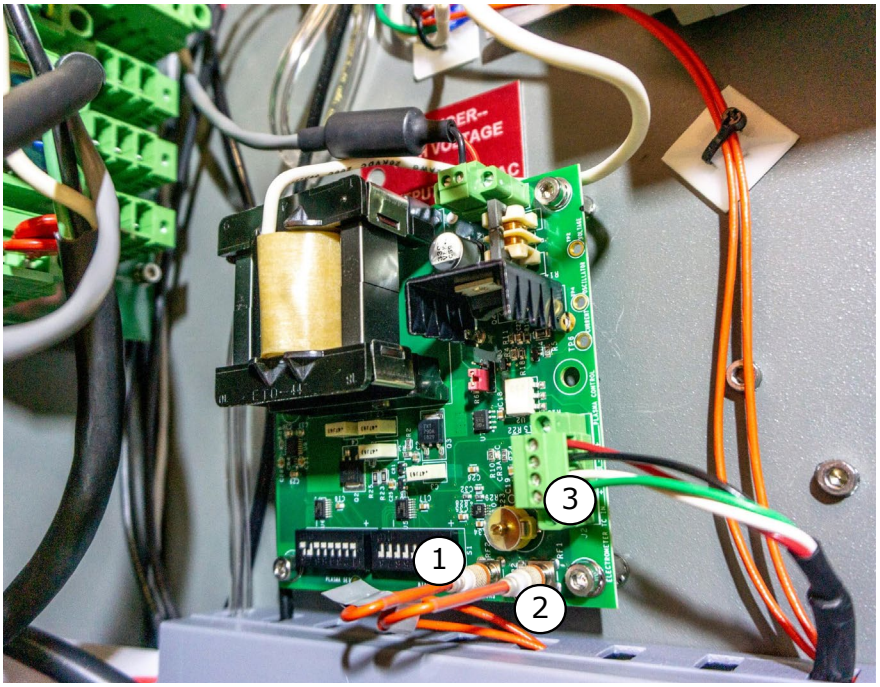
4. Open the left side oven door and disconnect the coax cable (item 1 in Figure 2-3) from the DBDID amplifier assembly.

Figure 2-3: DBDID amplifier assembly



5. On the DBDID power supply board, unplug the high voltage power connector (J2) (item 3), the bias cable (RF2) (item 1), and the feedback cable (RF1) (item 2). See Figure 2-4.

Figure 2-4: DBDID power supply board

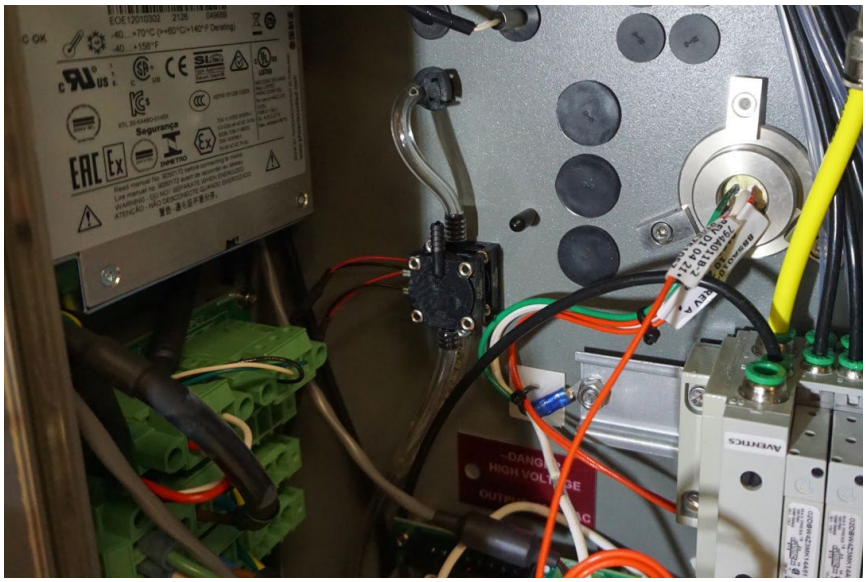


Legend: DBDID power supply board

Item	Description
1	Bias cable (RF2)
2	Feedback cable (RF1)
3	High voltage power connector (J2)

6. Loosen the 3 flange screws around the feedthrough tube.

Figure 2-5: Feedthrough tube



7. Unscrew the flange nut and remove the detector by pulling the detector to the inside of the oven. The wires coming from the feedthrough tube are potted so they will need to be fed through the opening to the inside of the oven.

2.2 Detector installation

To install the detector, perform the following steps:

WARNING – Bodily injury. High voltage present. Make sure that power to the PGC5000 has been disconnected before accessing the electronics compartment.

1. Remove power prior to installing the detector.
2. Perform the steps in section 2.1, above, in reverse order.
3. After reassembly, check for leaks.

2.3 Detector operation

This section details the steps to initialize operation of the detector.

IMPORTANT NOTE: Allow the oven to heat up and stabilize with flows enabled before setting the correct flow.

1. Set flows by measuring the flow at the cell vent tube. Refer to the data pack for correct flows.
2. The detector should automatically light when power is applied. To verify, remove the front cover of the detector and with low light you should be able to see the plasma glow a soft blue.
   a. To remove the cover, take the 16 screws out of the housing.
   b. Very gently pull the cover straight away from the body of the cell. Pay close attention not to rub any of the detector components while removing the cover. Be sure to observe the orientation of the cover and reinstall it in the same manner. Ensure the flame-proof or explosion-proof surfaces of the cover or the body of the detector are not damaged. Reinstall the DBDID detector cover and insert the 16 screws and tighten them to 16 in.-lb, using ABB Tool TL1000/TL1002. There is a small cutout inside of the cover that will need to go back on in the same orientation.

There is no need to push the DBDID ignite switch to light the plasma because when power and utilities are added, the plasma will automatically light.

NOTICE – Equipment damage. Take great care to avoid any leaks associated with this detector, as leaks can cause a variety of problems. See Troubleshooting in section 3.

2.4 Scheduled maintenance

There are no parts within the detector power supply or electrometer which require scheduled maintenance.

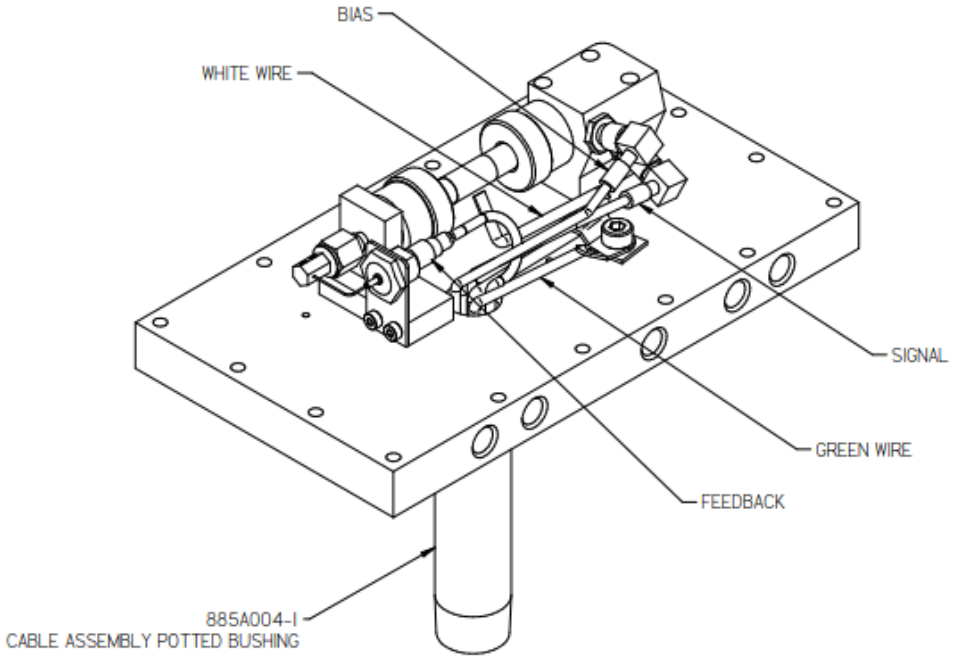
2.5 Recommended spare parts

Part Number	Description	Quantity
852A038-1	Power Supply DBDID	1
885A005-1	Detector Cell Assembly DBDID	1
851K006-1	FID/DBDID Amplifier Kit (Order 851K006-1 Amp Kit to build the standard 851A094-11412 per included 851J003 bulletin.)	1

Contact your local ABB sales and service representative for specific instructions for ordering spare parts. See the last page of this instruction for contact information. Always include the information listed in Equipment Identifications and Configuration Identification in your request.

When ordering parts for replacement, use the list of parts included in the Engineering Data Package that was provided with the analyzer to insure the correct version of each part.

Figure 2-6: DBDID drawing



3 Troubleshooting

This section describes general troubleshooting procedures, issues, and remedies.

Before proceeding with further troubleshooting procedures, first verify:

- The system has power.
- All switches and gas settings are correct.
- Column flow rates and pressure settings are correct.
- Using a VOM meter, verify the voltage between chassis ground and the test points on the bottom of the power supply board are as follows:
  - +10 volts DC Bias voltage
  - +2.5 volts DC Feedback voltage
  - +2.5 volts DC Plasma voltage

To determine the source of the problem:

1. Identify whether the problem is with the chromatographic oven or the detector. In general, if the problem is with component retention times and not component sensitivity, the problem is in the chromatographic oven and not the detector.
2. Ask: "What was the last thing done to the system?" Most problems are associated with the latest change made to the system, so this is the best place to begin look for the problem.

If the considerations above identify the detector as the primary cause of the malfunction, use the following sections to help identify and correct the problem.

3.1 Symptom – Plasma won't light

Possible Cause	Action(s)
No power	If the fuse is intact, contact customer support for further assistance.
Air in plasma	The presence of too much air in the plasma will often cause the plasma not to light. Purge the system with reaction gas for at least 15 minutes. If the plasma still will not light, check for air leaks in all of the fittings.
Back pressure too high	If there is too high of a restriction in the exhaust line, the detector plasma will not light. Replace the exhaust/signal tube with a new one and see if the plasma will light.
Wrong plasma gas	Verify that the reaction gas is either helium or argon. Replace if necessary.
Defective electronics	See sections 3.2 and 3.3.

3.2 Symptom – No signal

Possible Cause	Action(s)
No Power	If the fuse is intact, contact customer support for further assistance.
Air in plasma	Observe the plasma tube in a dark environment. There should be a pink or almost white glow in the plasma tube. If the tube is blue and the signal is low, there is nitrogen in the plasma. Verify that the correct reaction gas (helium or argon) is being used. Turn off the power to the plasma and check the gas supply, check for leaks, and verify the proper flow rate.
Signal cable problem	Verify that the collector shield BNC fitting contacts the exhaust tube. To do this, remove the BNC cable from the collector shield. Verify contact between the center pin of the BNC and the exhaust tube using a VOM or continuity tester. Re-connect the BNC cable to the collector shield. Verify the cable is connected to the collector shield and the electrometer board.
Wrong bias voltage	Using a VOM meter, verify the voltage between the Bias test point and chassis ground on the Power Supply Board. The voltage should be +10 volts DC.

3.3 Symptom – Low signal

Possible Cause	Action(s)
Leakage in the chromatographic system	Verify retention times for the analytes of interest. If OK, check for leakage on all the fittings on the detector end of the system. If retention times have shifted, check for leaks on the sample introduction side of the system.
Wrong reaction gas	Using nitrogen as a reaction gas will result in a low signal. Verify that the proper reaction gas is being used. Replace if necessary.
Plugged exhaust tube	Unique problem that will manifest itself with a lower signal and slower retention times. Visually inspect the exhaust tube to identify if any materials have plugged the tube. If plugged, insert a cleaning wire into the exhaust tube to remove the blockage. If these actions do not correct the problem, replace the exhaust tube.

3.4 Symptom – Excessive Noise

Possible Cause	Action(s)
Bad electrical connections	Check the signal cable connection and the bias voltage cable connection. Check the signal cable shield for fit. The fitting should be snug. Verify connection between ground rod and ground.
Air Leak	Leak-check all of the fittings within the oven system to verify a leak-free system.
Insufficient clearance for the plasma electrode	The plasma O-ring on the plasma tube is designed to prevent this issue. If the plasma electrode appears to be too close to the Swagelok® fitting, remove power from the analyzer and remove the plasma tube from the top nut. Install or replace the plasma O-ring on the plasma tube and re-install the plasma tube.

3.5 Symptom – Elevated baseline

Possible Cause	Action(s)
Poor carrier gas	Background signal is directly linked to the quality of gases being used. UHP (ultra-high purity) gases should always be used. If gas quality is suspected, replace gas with new UHP quality gas. When UHP gases cannot be used, a scrubber will need to be installed to remove excess levels of oxygen, water, and trace hydrocarbons.
Air Leak	An air leak in the chromatographic system can also cause an elevated baseline. Verify that there are no air leaks in the chromatographic system.

3.6 Symptom – Baseline drift

Possible Cause	Action(s)
Poor pressure control	Pressure controls not providing a consistent, pulse free, flow rate to the detector can cause detector drift. Monitor the pressure gauges on the supply cylinder and measure the flow out of the exhaust port over a one-hour time period to insure correct flow conditions.
Column bleed	Re-condition or replace the column.
Plasma cell leak	Initially, this may appear as column bleed, but the signal will equilibrate as the oven reaches an isothermal temperature. Reset the plasma cell in the Swagelok® fitting and tighten to leak-free.
Contamination or late-eluting peaks	It is possible that there is a late-eluting peak or contamination that is coming off the column several runs after it was introduced. Alter the cycle time of the injection to see is the baseline drift changes location. If this is confirmed, install filters to eliminate the contamination. Extend the instrument cycle time to elute the material prior to the next analysis.

3.7 Symptom – Spikes

Possible Cause	Action(s)
Loose connections	Verify that the signal cable is securely attached to the electrometer and the BNC fitting on the collector shield.
Missing ground leads	Verify that the ground lead from the plasma center electrode is connected. If it is not, power the analyzer down and re-connect the center electrode ground lead. Verify that the main power supply ground lead is connected to the appropriate oven chassis ground point.

Defective bias voltage	Using a VOM meter, verify the voltage between the Bias test point and chassis ground on the Power Supply Board. The voltage should be a stable +10 volts DC.

4 Specifications

Note: All specifications are subject to change without notice.

4.1 Physical

- Environmental (enclosure): The device is only suitable for use in clean, dry areas.
- Operating Temperature Range: 50 to 150 degrees C (122 to 302 degrees F)
- Installation and mounting: Integrated and configured with the PGC5000 series Smart Ovens.

4.2 Power

Voltage:

- Plasma reactor: 12V, 1.0 A
- Total power consumption: <20 W

4.3 Modes of operation

- Helium ionization mode (HID)

In this mode, the detector is sensitive to all organic and inorganic components except neon. Operating in HID mode, sub ppm levels of fixed gases can be measured.

- Argon ionization mode (AID)

In this mode, the detector is not sensitive to fixed gases and methane but is sensitive to a wide range of organic and inorganic volatile components. It is capable of ionizing any component with an ionization potential less than 11.5eV.

4.4 Detector sensitivity

Sensitivity is a function of the total application design. It depends on the mode of operation and the ionization potential of the analyte. Sensitivity values are given with a 4:1 minimum signal to noise ratio.

- HID mode: Sensitive to fixed gases down to 0.5 nanograms using hydrogen as an indicator.
- AID mode: Sensitive to benzene down to 20 picograms.

4.5 Gas consumption

Reaction gas flow:

- HID mode: 80 to 100 ml/min
- AID mode: 5 to 20 ml/min

Carrier gas flow:

- Packed columns: 20 to 60 ml/min
- Capillary columns: 5 to 30 ml/min

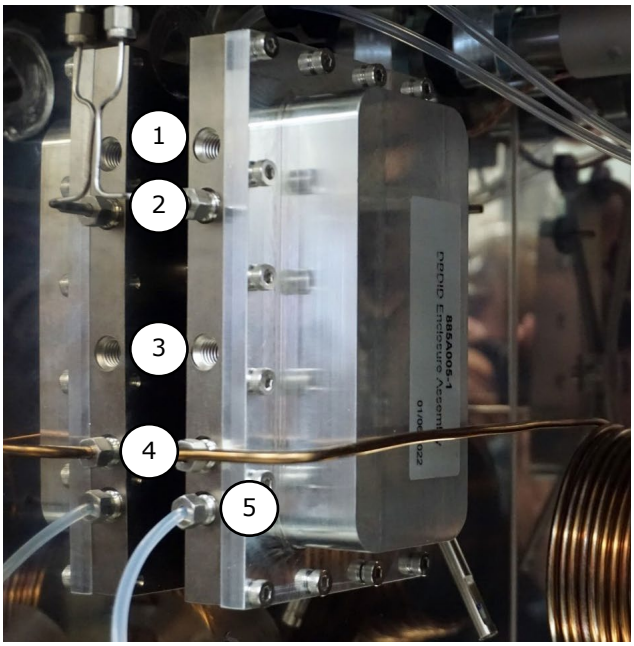
Utility specifications:

- UHP (ultra-high purity) for all carrier and reaction gas supplies.

5 Drawings

This section contains drawings pertaining to the DBDID as installed in the PGC5000 gas chromatograph.

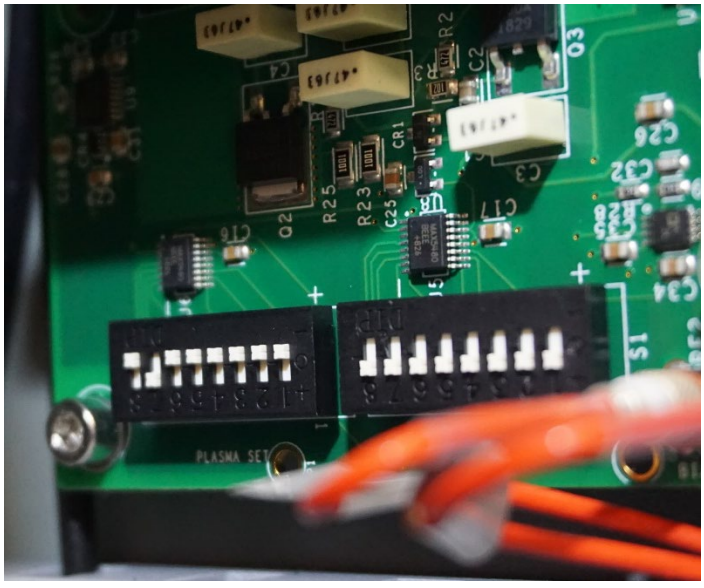
Figure 5-1: Detector port identification



Legend: Detector port identification

Item	Description
1	Purge gas inlet. (Detector assembly purge not used in most applications.) Flameproof breather must remain open or connected to optional purge system.
2	Reaction gas inlet (plasma gas)
3	Purge gas vent. (Detector assembly purge not used in most applications.) Flameproof breather must remain open or connected to optional purge system
4	Detector inlet (chromatograph column connection for analytes to the detector)
5	Detector vent

Figure 5-2: Power supply dip switch settings



NOTICE – Equipment damage. Dip switches on the power supply should never be adjusted without factory support.

Figure 5-3: Diagram flow PGC5000 air and carrier

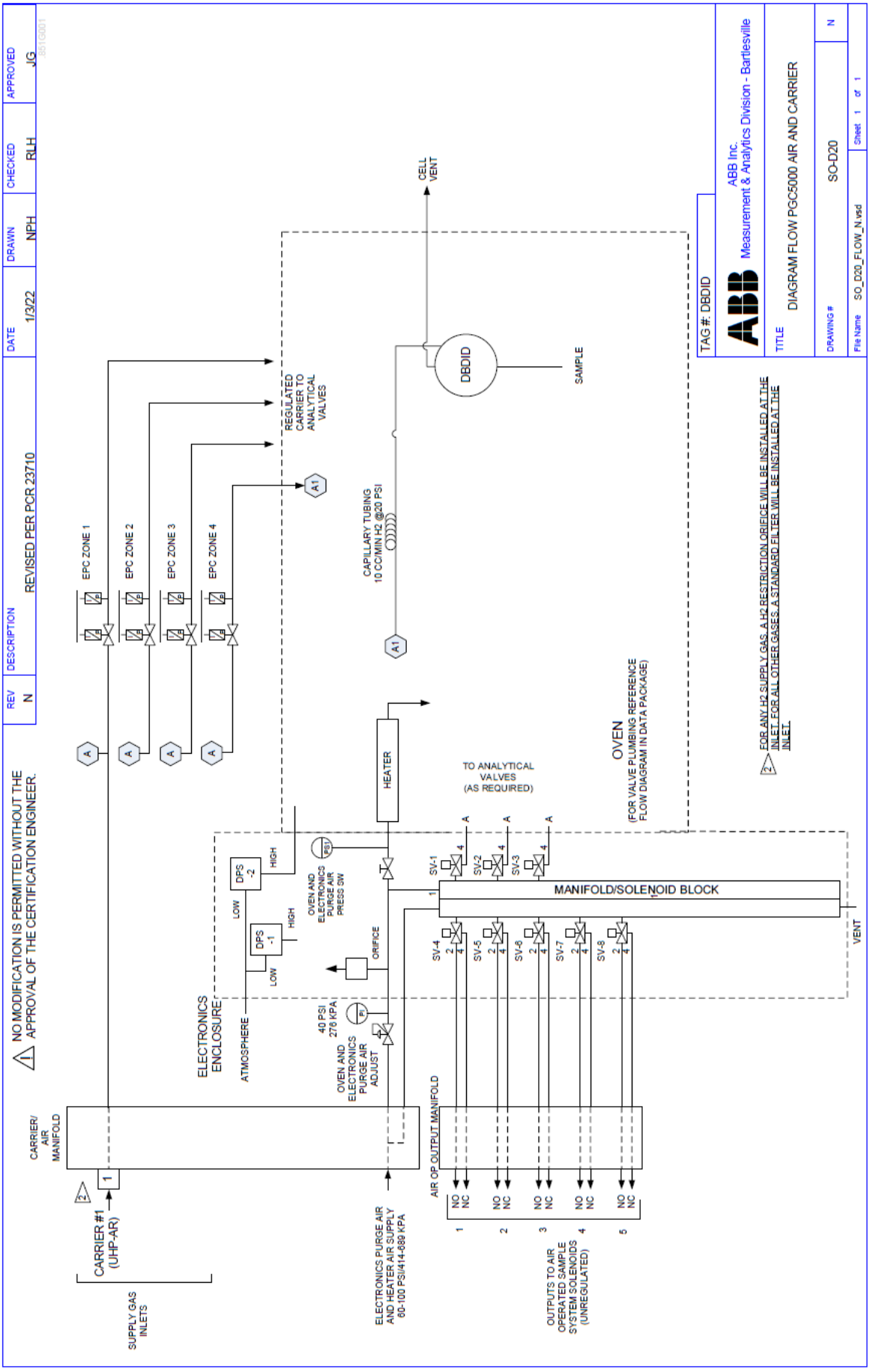


Figure 5-4: PGC5000 oven electronics internal connections diagram sheet 1

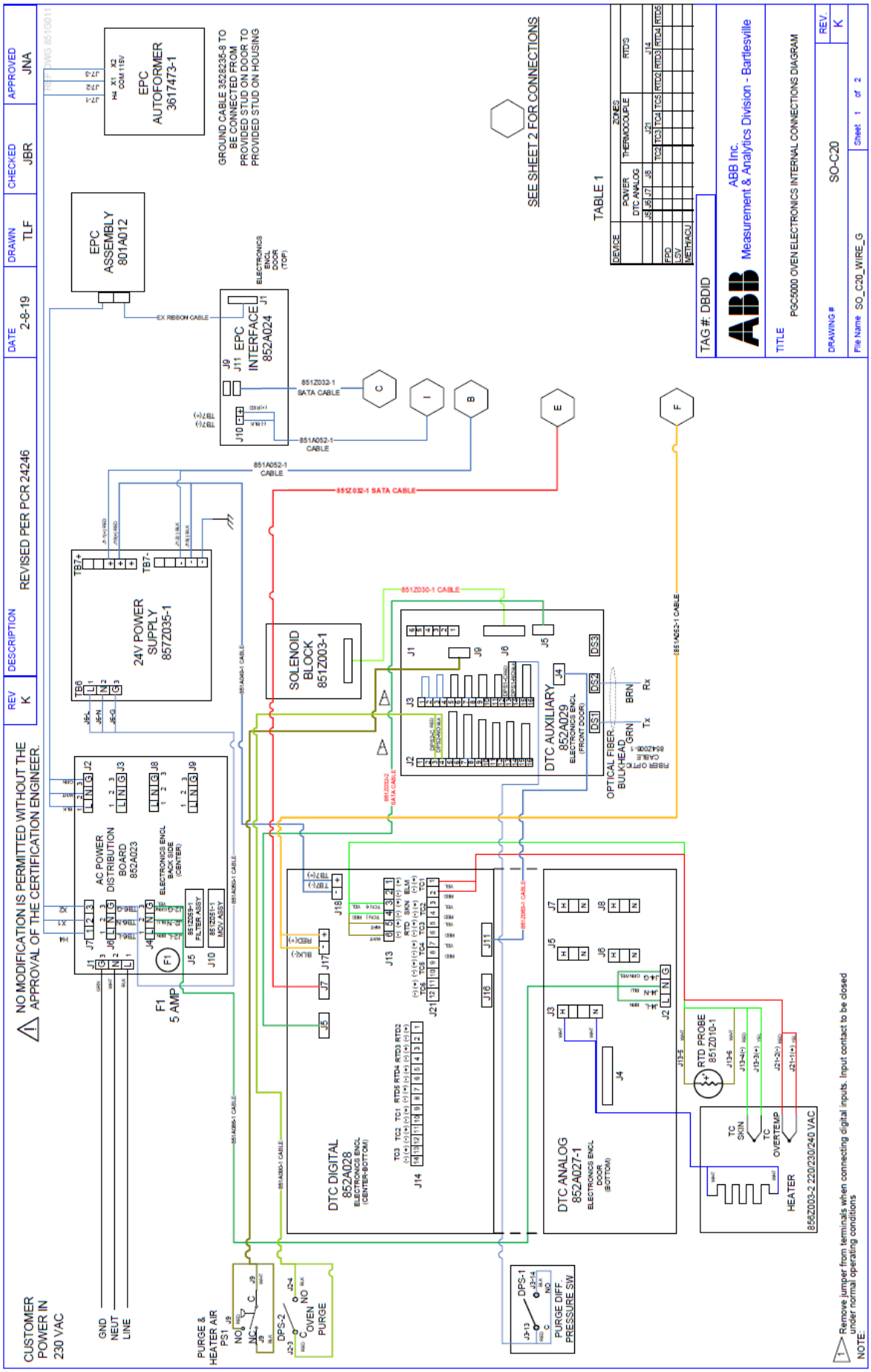
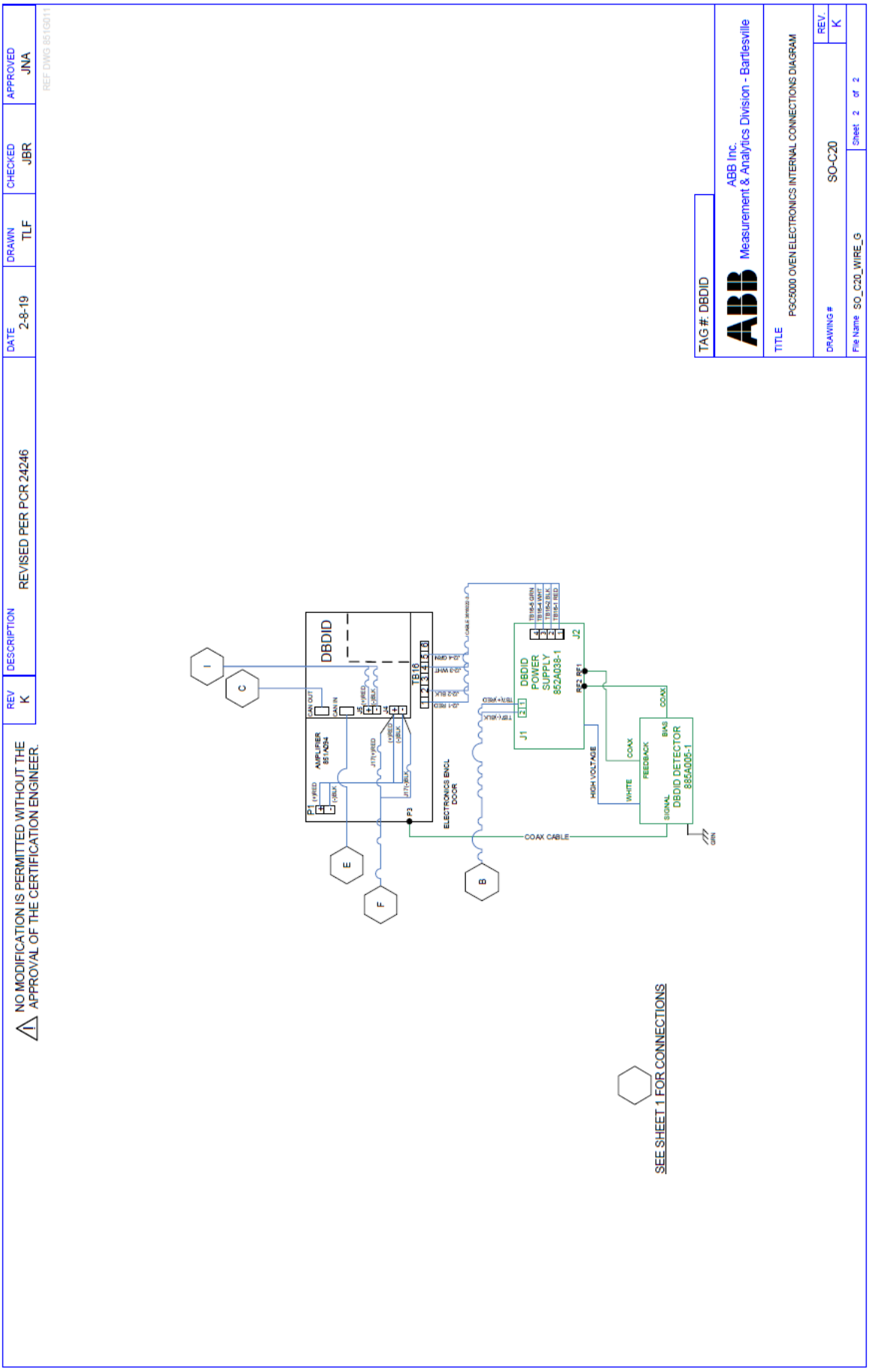


Figure 5-5: PGC5000 oven electronics internal connections diagram sheet 2



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Bartlesville, OK 74006
Ph: +1 918 338 4888

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Houston, TX 77042
Ph: +1 713 587 8000

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